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Interface defects of Al/GaAs(100) detected by Positron Annihilation Induced Auger Electron Spectroscopy (PAES)

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Abstract

The interfacial layers between a metal overlayer and the semiconductor substrate are an integral part of semiconductor devices. As devices continue to shrink and epitaxial layers are made thinner, device performance has become more and more dependent on interfacial structure and interfacial defects. In this paper we present results that suggest that PAES intensities can be used as a probe of defects formed at the interface of ultra-thin Al films epitaxially grown on GaAs (100). PAES spectra were obtained from a 99.99% pure Al foil and from a thin film formed by the deposition of 10 Å of Al on a GaAs (100) substrate. Comparison of the Al PAES intensities obtained for these two systems revealed that the Al PAES intensity from the 10 Å Al thin films is only 42% of that of the PAES intensity from the Al foil. Measurements of sputtered and oxygen exposed Al foil surfaces indicated that the small level of oxygen contamination found for the Al/GaAs surface is not sufficient to account for the observed decrease. Since the PAES intensity is directly proportional to the number of implanted positrons that diffuse back to the surface, the reduction in intensity observed for the Al overlayer suggests that 58% of the injected positrons are trapped at the interface defects. Our results suggest that it may be possible to use PAES intensities as a nondestructive prediction-sensor to detect the interfacial defects during IC fabrication.

Keywords

Annihilation, Auger, Defect, Interface, Metal, Positrons, Semiconductor